Applying Systematic Instruction to Teach ELA Skills Using Fictional Novels via an iPad App

Mims, Pamela J.; Stanger, Carol; Sears, Julie A.; White, Wendee

Published in:
Rural Special Education Quarterly

DOI:
10.1177/8756870518784711

Publication date:
2018

Document Version
Peer reviewed version

Rural Special Education Quarterly

Applying Systematic Instruction to Teach ELA Skills Using Fictional Novels via an iPad App

Journal:	*Rural Special Education Quarterly*
Manuscript ID	RSEQ-17-0055
Manuscript Type:	Research Reports
Keywords:	intellectual < Disability/ies, Instructional strategies, single-subject/case < Research, Technology

Abstract:	Increasingly, researchers have successfully identified strategies to promote comprehension to students who are nonreaders. Further research is needed to replicate these promising results. In the current study, we used a multiple probe across participants design to evaluate the effectiveness of an iPad app, which incorporates evidence based practices such as constant time delay and system of least prompts, on the acquisition of targeted vocabulary and comprehension of four middle school students with significant intellectual and developmental disability (SIDD). Findings suggest that the intervention resulted in improved performance across all participants and that some generalization and maintenance of skills was seen. Limitations and implications for practice and future research are discussed.

Applying Systematic Instruction to Teach ELA Skills Using Fictional Novels via an iPad App

Abstract

Increasingly, researchers have successfully identified strategies to promote comprehension to students who are nonreaders. Further research is needed to replicate these promising results. In the current study, we used a multiple probe across participants design to evaluate the effectiveness of an iPad app, which incorporates evidence based practices such as constant time delay and system of least prompts, on the acquisition of targeted vocabulary and comprehension of four middle school students with significant intellectual and developmental disability (SIDD). Findings suggest that the intervention resulted in improved performance across all participants and that some generalization and maintenance of skills was seen. Limitations and implications for practice and future research are discussed.

Applying Systematic Instruction to Teach ELA Skills Using Fictional Novels via an iPad App

Current expectations have challenged teachers to better prepare students with SIDD for success in their post-school lives by helping students to excel within the general curriculum, including English/Language Arts (ELA; National Governors Association [NGA], 2010). State standards in ELA require students to access and understand a variety of texts encountered in daily life as well as to develop skills in writing, research, and communication, yet the research has not caught up to current curricular requirements for students with SIDD. Literature in the field has highlighted several factors such as low academic expectations and poor quality or even the absence of instruction (Erickson, Hanser, Hatch, & Sandars, 2009; Katims, 2000; Kliewer & Biklen, 2001). In addition, much of the literature on literacy instruction for this population have narrowly focused on sight word instruction (Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006), yet sight word instruction has little impact on comprehension.

Teaching comprehension requires higher order thinking skills. In the 1950's, Bloom (1956) classified educational goals and objected with the idea of the taxonomy as the complexity of skills moved up the hierarchy for student skill building (Bloom, 1956). Anderson and Krathwohl (2001) revised Bloom's Taxonomy to modernize educational objectives by re-coining terms to be active verbs versus nouns and reversing the order of the two highest levels (Anderson & Krathwohl, 2001). Yet, little has been researched for students with disabilities, past the basic levels of understanding in Bloom's Revised Taxonomy (Anderson & Krathwohl, 2011).

In 2004, Al Otaiba and Hosp's literature review primarily found studies for sight word retention, phonemic decoding, and phonological awareness, one study supported the integration of phonics and basal reading instruction, but found no studies that investigated fluency, vocabulary, or reading comprehension (Al Otaiba & Hosp, 2004; Coyne, Pisha, Dalton, Zeph, &

Smith, 2010). A few years later, Browder and her team completed a framework analysis of 128 studies on teaching reading to student with moderate to severe intellectual disabilities ((Browder, Wakeman, Spooner, Ahlgrim-Dezell, & Algozzine, 2006). The vast majority of the studies examined only one or two areas of literacy instruction and more than two-thirds examined the teachings of sight words with an emphasis on functional words (Browder, Gibbs, Ahlgrim-Delzell, Courtade, & Lee, 2007).

Over the past several years, researchers began to focus on the Revised Bloom's Taxonomy (Anderson & Krathwohl, 2001) level of comprehension and other higher order of thinking skills for ELA and are now beginning to apply comprehensive approaches to literacy for students with SIDD (Browder, et al., 2007). In 2012, Mims, Hudson, and Browder used a read aloud approach to teach WH (WANT, HOW) questions after reading adapted grade aligned biographies to middle school students with moderate to severe disabilities and/or autism. A modified system of least prompts and a graphic organizer was used to teach who, what, when, where and why questions. The authors used a multiple probe across participants single case design to investigate the effects of the intervention. Results indicated that all the students met were able to increase the number of correct student responses to WH questions and maintained their knowledge over time.

While Mims et al. (2012) focused on teaching wh-questions, Mims, Lee, Browder, Zakas, and Flynn (2012) implemented a more comprehensive approach to teaching grade aligned ELA with a heavy focus on comprehension across Bloom's Taxonomy. Using a one group, nonrandomized, pre- and post-test design with fifteen middle school students with SIDD, they found that scripted lesson featuring systematic and direct instruction (i.e., system of least prompts, model-lead-test) led to gains in comprehension (e.g., literal recall, inferential,

sequencing, story grammar, synthesis) across genres of text, as well as gains in vocabulary, student led research skills, and opinion writing skills.

In an attempt to replicate the above results using a more robust design, a second study was conducted with thirty students with SIDD using a non-equivalent group research design with a pre-posttest (author citation, in preparation) to examine effects of a scripted curriculum, which included systematic and direct instruction, on a wide range of grade aligned ELA skills, including comprehension. Students were assessed using two pre- and post-tests. One assessment was a curriculum based measure which featured familiar texts from the curriculum. The second assessment was a generalization measure which featured unfamiliar text, but measured the same type of skills taught throughout the curriculum (e.g., comprehension, writing, student-led research). Significant effects were found for both the direct and generalization measures in comprehension as well as other targeted skill areas (e.g, vocabulary, student led research skills, opinion writing skills)

In addition to the above studies, technology has started to play a role in instruction of grade aligned academics for students with SIDD. For example, authors (in submission) used single case multiple probe across participants design to investigated the effects of an iPad app featuring embedded systematic instruction (e.g., system of least prompts) and adapted grade aligned nonfiction stories on the acquisition of comprehension and targeted vocabulary. Three students with SIDD participated in the study. Results showed a functional relation between the app featuring systematic instruction and listening comprehension (e.g., literal recall, inference, three-step sequence, application, analysis, prediction, main idea, main character, setting, problem and solution) of the targeted students. Similarly, Spooner, Kemp-Inman, Ahlgirm-Delzell, Wood, and Davis (2015) investigated the effects of using an iPad paired with systematic instruction on

listening comprehension skills with the use of shared stories for five students with SIDD. Results found a functional relation between the use of the iPad and systematic instruction and listening comprehension.

Although several studies have focused on effective strategies to promote listening comprehension of grade aligned text for students with SIDD, to date, few studies have been conducted to examine the effects of mobile technology, such as iPads, on listening comprehension. This study further investigates the effects of an iPad application with embedded systematic instruction and read aloud approach of grade-aligned adapted fictional novels on ELA skills with middle school students, with SIDD in rural settings. Specifically, the following research questions were targeted: (1) What was the effect of the iPad ELA app, *Access: Language Arts* (Attainment Company, 2016), with embedded read aloud of grade level adapted fiction stories and systematic instruction on student's targeted ELA skills? and; (2) What was the effect of the iPad ELA app (*Access: Language Arts*) on overall student engagement?

Method

Participants and Setting

Four students, ages 9 to 12 years old, participated in this SID study. All students were from a self-contained classroom which served students with significant disability. The inclusion criteria included: (a) use of sight words or symbol reading repertoire; (b) moderate to profound intellectual disability or autism; (c) ability to make selections from an array on the iPad; (d) available for the study three times a week; e) in grade 5-8; and (g) participating in their states alternate assessment based on alternate achievement standards. Table 1 for student demographics.

Student 1 was a 12-year-old Caucasian female in the 7th grade. She was identified as having a significant intellectual disability, cerebral palsy, seizures and Rett's syndrome. She was conversational and recognizes some sight words and had little to no exposure to grade aligned text or ELA instruction.

Student 2 was a 12-year-old Caucasian male in the 7th grade. He was identified as having a significant intellectual disability. He was conversational and recognizes some sight words and had little to no exposure to grade aligned text or ELA instruction.

Student 3 was 9-year-old Caucasian female in the 5th grade. She was identified as having a significant intellectual disability. She was conversational and recognizes some sight words but had little to no exposure to grade aligned text or ELA instruction.

Student 4 was an 11-year-old Caucasian male in the 6th grade. He was identified as having autism and significant intellectual disability. Dan was extremely limited in conversation. He has had little to no exposure to grade aligned text or ELA instruction.

The study was conducted in a two rural public middle schools in southeastern United States. Individual sessions took place in a quiet setting away from the other students in the classroom to provide for control of overexposure to the other students. Sessions occurred, at minimum, three times per week and lasted approximately 40 minutes per session.

Two teachers served as interventionists for the study. The teacher for Student 4 had a master's degree in special education with a focus on severe disabilities. She had been teaching for one year in classrooms for students with moderate to profound, multiple disabilities and/or autism. She typically used direct, systematic instruction in a one to one format to teach targeted ELA skills for about 20 minutes daily and also used small group instruction using Unique Learning Systems curriculum for 30 minutes daily. Before this study, she did not use middle

grade texts for her students. The teacher for the other participating students had also held a master's degree in special education. She had been teaching for 14 years in classrooms for students with severe behavior concerns, resource classrooms, as well as her current placement which was a classroom for students with moderate to profound intellectual disability and/or autism. She reported teaching ELA for about 2 hours a day using whatever supports she could find. The teachers were trained to conduct the baseline and intervention procedures by the principal investigator and the grant research associate.

Research Design

A multiple probe across students single case design (Gast, 2010) was used to evaluate the efficacy of the comprehension intervention. Study phases included baseline, intervention, generalization, and maintenance. The teachers conducted baseline sessions for at least three sessions for each participant on a chapter pair prior to entering intervention. Once data were stable for the first participant, we introduced intervention and collected data across the remaining story chapters. Once a change was observed the first participant, we reprobed remaining participants in baseline to ensure data were still low and stable or descending. The next participant with low and stable or descending data entered the intervention. This same process continued until all participants were in the intervention. We collected and graphed data on the percent of unprompted correct responses across baseline, intervention, generalization, and maintenance sessions.

Investigators were interested to determine if students began new lessons in the story with a higher level of comprehension questions correct. To address this, generalization probes of chapter pairs were conducted prior to students entering the intervention phase with a new chapter

pair. These probes indicated the number of correct unprompted responses to vocabulary and comprehension questions for the next chapter pair to be (see Figure 1).

Materials

Two versions of an iPad app were created for the study by Attainment Company. A baseline version and intervention version (*Access: Language Arts*). Both reflected an adapted version of *Outsiders,* a fictional novel often targeted in Middle School ELA. The selected text also was pulled from the validated *Teaching to Standards: ELA* curriculum (Attainment Company). The text was adapted for non-readers by summarizing text using controlled vocabulary, reducing the overall lexile level to a 2nd-3rd grade reading level, and pairing keywords with picture symbols. The adapted chapter pairs were short enough to be read entirely in one teaching session. Vocabulary, comprehension questions, including prediction questions were established and validated by a content expert for each chapter pair and included in the application. The intervention version of the app was preprogrammed to be read aloud by a female human voice, presented highlighted text as it was read aloud, included vocab words underlined in the text that could be touched and provided a verbal definition, and a repeated storyline that summarized the main idea of the chapter (which was read aloud by a human male voice). The baseline version of the app was a Text to Speech (TTS) read aloud and did not contain the highlighting as the words were read or the underlined definitions.

Students responded to questions (i.e., vocab identification, vocab definition, & comprehension) that were built in to the application by selecting one of three response options. Response options included a combination of picture symbols and words. Each comprehension question included a correct response and two plausible distracters (e.g., if the question asked about a person, all response options were people). Both the target and distracter options

contained picture symbols along with the text (e.g., the text 'Pony Boy' along with a pic sym of Pony Boy). The position of the response options was randomized by the app so that students did not memorize placement of correct answers. The student response features were identical for both of the baseline and intervention versions of the app, except the baseline version did not include any picture supports.

In the intervention version of the app, systematic instructional strategies were programmed into the application to deliver instruction as needed throughout the sessions. Constant time delay was built in to teach vocabulary identification and definitions and included two rounds of a zero-time delay followed by one round of a five second delay for each word presented. This also occurred for the definitions. The system of least prompts was applied to the app to teach comprehension. For example, when asked the literal recall questions and presented with three response options, the student would indicate a response by selecting one of the response options. But if the student could not remember the answer and wanted to look back at the text, a 'hint' button was available which took them back to the page containing or alluding to the answer. This page was read aloud and then they were taken back to the question page and had a chance to indicate their response. If the student chose the wrong answer the app automatically returned to targeted text page, re-read the page, then returned to the comprehension question page where the initially selected incorrect response option was grayed out and could not be selected again. The question was re-asked and the remaining response options were presented. The process was repeated until the student selected the correct answer. Essentially this modeled a least to most prompt hierarchy which included a reread of the page containing or alluding to the answer and graying out an incorrect response, a reread of the paragraph containing or alluding to the answer and graying out another incorrect response option, and finally a reread of the line alluding to or

containing the answer with only the correct answer available to select (2 incorrect answers were grayed out) In addition to the system of least prompts and constant time delay, error correction and positive reinforcement were also utilized within the app. Error correction occurred by graying out a selected incorrect response. Reinforcement was provided when the student selected the correct answer. This included various specific praise statements (e.g., "Good job. The main character for these chapters was Ponyboy.") and the app automatically moved on to the next question. For story grammar (i.e., main character, setting, problem, solution, main idea), before the question would be read aloud, the definition would be provided. For example, the main character question page would come up and the app would say, "A main character is the most important person in our chapter." Followed by the question "Who is the main character in these chapters?". Finally, data were collected by the application and was emailed out to the teacher and researchers upon completion of the intervention session.

Dependent Variable and Data Collection Procedures

The dependent variable was the percent of unprompted, correct responses to ELA skills (i.e., vocabulary identification and definition as well as comprehension questions). For each chapter pair, data were collected on the identified four target vocabulary words (both identification and definition) as well as the following comprehension questions: literal recall, inferential, 3-step sequence (identification for each step of the sequence was assessed separately), application, analysis, main idea, main character, setting, problem, and solution. Data were also collected on prediction, but were not included in the graphed data as making a prediction is not necessarily right or wrong, rather it tells the teacher if the student is gleaning the best information to make a strong prediction. Data summarized the number of correct unprompted responses to vocab id, definition, and comprehension questions after the read aloud

of an adapted chapter pair. For baseline sessions, the teachers provided a vocabulary identification and definition probe as well as asked all comprehension questions, via the baseline version of the app, after the read aloud of the chapter pair and waited 5 s. for the student to respond. The teachers immediately scored student responses on a data sheet as a "+" for correct responses and a "-" was recorded for an incorrect or no response (after 5 s.).

For intervention sessions the application was programmed to collect data on a vocabulary probe (identification and definition) and instructional data on the comprehension questions. The app scored the students' level of prompt needed to identify the correct answer. Essentially the data provided reflected if the student independent answered without prompting from the app, or if the student needed a 1st level, 2nd level, or 3rd level prompt, which ultimately reflected the system of least prompts and could be comparable to a verbal prompt, model prompt, or physical prompt. Graphed data only reflected the independent unprompted correct responses.

Maintenance. Maintenance data were collected at least two weeks after the intervention was completed. Maintenance conditions were the same as baseline conditions. The students repeated a session for *Outsiders* chapter 1 and 2.

Generalization. Generalization of learned skills were measured during the introduction of new chapter pairs. Generalization probes followed the same procedures as baseline sessions.

Social validity. Teacher opinions of *Access: Language Arts II* was obtained by conducting a social validity measure. The classroom teachers (both interventionists) completed a social validity form for each student after the study was complete. Using a 5-point Likert scale, they indicated the level of agreement or disagreement with 16 statements by circling one of five responses (a) 5 = strongly agree, (b) 4 = agree, (c) 3 = neutral, (d) 2 = disagree, and (e) 1 = strongly disagree. Statements measured both study procedures (e.g., the system of least prompts

via the iPad is appropriate for the student) and outcomes (e.g., the adapted texts helped access the general curriculum for this student). Additionally, open-ended questions were asked to both teachers to get a better idea of procedures and outcomes.

Engagement. Data were also collected on the overall engagement level of the student during the intervention sessions. The level of engagement of each student was rated by the teacher after instructional sessions and after observations by the graduate research assistant, and discussed during a follow up teacher interview using the following scale: 1) Does not participate at all (e.g., does not look at/in the direction of the iPad); 2) Passively participates (e.g., looks at the iPad or teacher as they respond, but makes no attempt to respond to teacher directions or iPad application directions without assistance); 3) Occasionally participates (e.g., looks at the iPad or teacher as they respond and makes attempts to respond less than half of the questions asked); 4) Usually participates (e.g., looks at the iPad or teacher as they respond and makes attempts to respond 50 to 75 percent of the questions asked); 5) Actively participates most of the time (e.g., looks at the iPad or teacher as they respond and makes attempts to respond to more than 75% of the questions asked); and 6) Actively participates all of the time (e.g., looks at the iPad or teacher as they respond and makes attempts to respond to all questions asked).

Inter-observer agreement (IOA) and procedural fidelity (PF). A trained second observer (i.e., graduate research assistant) calculated IOA on the number of correct student response data for 32% of the baseline and intervention sessions. IOA was calculated by taking the number of agreements divided by the number of agreements plus disagreements and multiplying by 100. IOA for baseline and intervention sessions was 99% (87% to 100% range).

The same graduate research assistant scored 64.5% of baseline sessions and 29.75% of intervention sessions using a PF checklist. We calculated PF by dividing the number of steps

delivered correctly by the total number of procedural steps and multiplied by 100. PF for baseline and intervention sessions was 96% (range= 78%-100%).

Additionally, IOA of the PF checks were evaluated for 41% of the baseline and intervention sessions. Scoring by the lead research associate was compared to the original scoring by the graduate research assistant using an item-by-item method to obtain the percentage of agreement. IOA of PF was 95.35% (range= 89-100%).

Procedures

Baseline. The teacher and students sat side-by-side at a table for all sessions. The iPad with a baseline version of the app (which included Text To Speech (TTS) read aloud of the adapted chapter book and no prompting, praise, or error corrections) were used during baseline. The teacher started by introducing the targeted lesson and told the student they were going to read (or continue reading) the book *The Outsiders*. The teacher proceeded by opening up the app with the adapted chapter book using the TTS version, and read aloud the title and author and selected the targeted chapters to be read. Before reading, the teacher provided the student with a short "story walk" where the app showed 5 pages of the text to be read to the student for about 5 seconds. This was followed by the teacher reading the prediction question (e.g., "What do you think these chapters are going to be about?") and three response options. The teacher waited 5 s. for the student to make a response. The teacher recorded the data based on the student response and moved on to the read aloud of the targeted chapters. The teacher helped the student stay on task while they progressed through the chapter text with TTS read aloud. At the end of the story, the student pushed the test button and was probed on all vocabulary and comprehension questions. The vocabulary probe consisted of four targeted words cards from the chapter pair being placed in a 2x2 array presented via the app. The app asked the student to touch the targeted

work and wait 5 s. before shuffling the cards (in order for the cards to be presented in a random order) and asked them to identify the next word. This continued until all 4 words had been probed on word identification. The same procedures occurred for the definition probe. The 4 targeted words appeared in a random 2x2 display and the app asked the student to identify the word that means …(followed by the definition). Again, the app waited 5 s. before shuffling and moving on to the next definition. After each word identification or and definition, the teacher collected the student data on the data sheet. The teacher moved on until all 4 words had been probed on both identification and definition. The app then moved to the comprehension question portion. After a question was asked and the response options were read aloud by the app, the student picked an answer from an array of three response options (i.e., the correct answer, a close distractor, a highly disparate distractor). The teacher looked expectantly at student, and waited 5 s. for a response. Data were recorded and this continued until all questions had been asked. Neither the teacher nor the app prompted or praised student responses, although, general verbal praise was given for on-task behaviors (e.g., looking at the story, sitting with hands to themselves).

Intervention. Students progressed through the app as follows. First, the students selected the targeted story chapters. Professional narration read the title and author of the story aloud to the student. Next, vocabulary instruction was provided for the targeted story using constant time delay. After vocabulary instruction, the student previewed the story. The preview was a short "story walk" where the first page of every chapter and the last page (5 pages total) were shown to the student for about 5 s. followed by a prediction question (i.e., "What do you think this story is going to be about?") and three response options. A correct answer was not given; instead, the app continued by saying "You think the story is going to be about (fill in student response). Let's

find out." After prediction, the story was read aloud to the student with professional narration, highlighting word by word as it was read. In addition, key vocabulary words were underlined in the text. If the student touched the vocabulary word, the definition was shown and read aloud. Students moved through each page of the story by selecting the "turn page" button at the bottom, right hand corner of the iPad screen. Once finished with the reading, the app reviewed the prediction question and prompted the student to the correct answer. The app then initiated a vocabulary probe that included word identification and definition. After the vocabulary probe, the app progressed through the comprehension and story grammar questions (i.e., literal recall, inferential, 3 step sequence, main idea, application, analysis, main character, setting, problem, solution). Students were presented with the same chapter pair for three consecutive sessions. We then presented a single baseline probes on the next chapter pair before entering intervention with that chapter pair. We conducted these probes to assess whether students had generalized their comprehension skills to untrained chapter content.

Data Analysis

Both baseline and intervention data were analyzed. During baseline and intervention, the number of correct unprompted responses were graphed. Data were analyzed by visually inspecting graphed data to identify trend, level, and variability and to determine if a functional relation existed between the independent and dependent variables. Prediction, verification of prediction, initial effect, and replication of effect were assessed for all students and biographies.

Results

Figure 1 provides the percent of correct responses to vocabulary and comprehension questions during baseline and intervention sessions. Student 1 was stable during baseline sessions with a mean of 26.6% correct (range of 25-30%). During intervention she immediately

increased to 81.6% correct (range of 75-85%) on chapter 3 and 4. When reprobed for generalization on chapter 5 and 6, student 1 dropped down to 25% correct which indicated that she had yet to generalize skills to untrained content. During intervention on chapter 5 and 6, she again increased her mean percent correct to 63% correct (range 50-80%). When reprobed for generalization on chapter 7 and 8, she again dropped down to 25% correct. During intervention on chapter 7 and 8, student 1 increased again to a mean percent correct of 88% (range 85-90%). For her final generalization probe on chapter 9 and 10, she scored 50% correct indicating some generalization. During intervention on chapter 9 and 10 she scored a mean of 75% correct (65-90%). For her final maintenance datum point, she scored 65% correct indicating she was able to generalize learned skills to chapter 1 and 2 as well as maintain her scores over time. Over all, student 1 had an increase from a baseline mean of 26% correct to an intervention mean of 77% correct.

Student 2 was stable during baseline with a mean 28.75% correct (3 probes in chapter 1 and 2 and one probe in chapter 3 and 4; see Figure 1). During intervention in chapter 3 and 4, he immediately increased to a mean of 88% correct (range 80-95%). When reprobed for generalization on chapter 5 and 6, student 2 dropped down to 25% correct which indicated that he had yet to generalize skills to untrained content. During intervention on chapter 5 and 6, he again increased his mean percent correct to 78% correct (range 55-90%). When reprobed for generalization on chapter 7 and 8, he scored 45% correct, indicating he was starting to generalize some skills to untrained content. During intervention on chapter 7 and 8, student 2 increased again to a mean percent correct of 77% (range 65-85%). For his final generalization probe on chapter 9 and 10, he scored 55% correct indicating further generalization. During intervention on chapter 9 and 10 he scored a mean of 82% correct (80-85%). For his final maintenance datum

point, he scored 50% correct indicating he was able to generalize some learned skills to chapter 1 and 2, but maintenance was not as strong. Over all, student 2 had an increase from a baseline mean of 28.75% correct to an intervention mean of 81.25% correct.

Student 3 also indicated an initial stable baseline (mean of 26.6%; range of 25-30%), but when reprobed on chapter 3 and 4, after student 1 indicated jump in level and trend, student 3 scored 65% correct. Researchers decided to hold off intervention and reprobe chapter 3 and 4, when student 2 indicated a change in level and trend. After this occurred (when student 2 entered intervention), student 3 was reprobed and dropped down to 20% correct. Researchers decided to start intervention on chapter 3 and 4. During intervention in chapter 3 and 4, she immediately increased to a mean of 45% correct (range 35-55%). When reprobed for generalization on chapter 5 and 6, student 3 dropped down to 15% correct which indicated that she had yet to generalize skills to untrained content. During intervention on chapter 5 and 6, she again increased her mean percent correct to 57% correct (range 50-65%). When reprobed for generalization on chapter 7 and 8, she scored 45% correct. During intervention on chapter 7 and 8, student 3 increased again to a mean percent correct of 57% (range 45-65%). For her final generalization probe on chapter 9 and 10, she scored 35%. During intervention on chapter 9 and 10 she scored a mean of 63% correct (40-80%). For her final maintenance datum point, she scored 70% correct indicating she was able to generalize some learned skills to chapter 1 and 2, and maintained gained skills over time. Over all, student 3 had an increase from a baseline mean of 33% correct to an intervention mean of 55% correct.

Student 4 was stable during the initial three baseline probes with a mean 35% correct (Ch. 1 and 2) and continued on to be fairly stable across on the probes occurring as other students were about to enter intervention. In addition, we decided to probe him in chapter 5 and 6

before starting him in intervention just to check if he would still be low and stable in this content as he had been in chapter 3 and 4 for baseline conditions for 3 readings up to this point. This baseline probe of chapter 5 and 6 was low at 15% correct. Overall baseline mean was 32% correct (15-45% range). During intervention in chapter 5 and 6, he increased to a mean of 42% correct (range 30-50%). When reprobed for generalization on chapter 7 and 8, student 4 dropped down to 35% correct which indicated that he had yet to generalize skills to untrained content. During intervention on chapter 7 and 8, his mean percent correct was 35% (range 30-40%). When reprobed for generalization on chapter 9 and 10, he scored 20% correct. During intervention on chapter 9 and 10, student 4 increased again to a mean percent correct of 77% (range 65-85%). For his final generalization probe on chapter 9 and 10, he scored 55% correct indicating further generalization. During intervention on chapter 9 and 10 he scored a mean of 37% correct (25-45%). For his final maintenance datum point, he scored 30% correct indicating low generalization and maintenance of skills. While student 4 had little gains, he did increase from a baseline mean of 32% correct to an intervention mean of 38% correct.

Engagement. Overall student engagement, was reported to be a mean of 5 on the 6 point Likert scale, indicating the students actively participates most of the time with engaging with the iPad app and teacher higher than 75% of the time. Student 1 was recorded to be engaged at a mean of 6 for every session. Student 2 had a range of engagement from 4 to 6 with an average of 5. Student 3 also averaged at 5, with a range from 3 to 5. Student 4 had the lowest engagement with a mean 3.5 and a range of 1 to 5.

Social validity. Teacher opinions of the comprehension focused study were obtained by conducting a social validity measure. The classroom teachers completed a social validity form for each student after the study was complete. Using a 5-point Likert scale, the classroom

teachers indicated the level of agreement or disagreement with statements by circling one of five responses: (a) 5 = strongly agree, (b) 4 = agree, (c) 3 = neutral, (d) 2 = disagree, and (e) 1 = strongly disagree. Statements measured both study procedures (e.g., "The system of least prompts via the iPad is appropriate for the student and outcomes (e.g., "The adapted texts helped access the general curriculum for this student"). Results indicated that the participating teachers either strongly agreed or agreed with most all questions related to usability and feasibility as well as overall social validity of the procedures and outcomes. Additionally, the teachers answered several open-ended questions designed to provide detailed feedback for our iterative process. They reported that access to grade aligned content and materials through the app were extremely helpful and that the students were very engaged during the iPad app lessons. They reported that the use of the app in small group instruction was something they were interested in as one to one instruction used up a lot of instructional time, but understood that the one on one format was necessary for the research.

Discussion

Studies focused on teaching listening comprehension to students with SIDD via mobile technology (e.g., iPad) are limited, however, the results of this study provide additional support to the efficacy of the use of an iPad app with embedded systematic instruction on increasing listening comprehension beyond just literal recall for students with SIDD. Specifically, middle grade students with SIDD in rural settings increased the percent independent correct vocabulary identification and definition, and comprehension after listening to an adapted version of *Outsiders* via the iPad app, *Access: Language Arts*. In addition, three students were able to maintain their results over time and two students demonstrated some generalization of skills to untrained chapters.

This study, like author (in submission) and Spooner et al., (2015) found the use of iPads with embedded systematic instruction to be an effective strategy to promote listening comprehension and overall engagement for students with SIDD. Students in this study were provided access to an adapted version of Outsiders read aloud via an iPad app, instruction in targeted vocabulary from the adapted story using constant time delay, and instruction in comprehension (i.e., prediction, literal recall, 3-step sequence, inferential, application, analysis, including story grammar (i.e., main character, setting, problem, solution, main idea). Three of the four students made major gains across all of the skills. Student four made small gains, but it was noted that he was struggling with several inappropriate behaviors across his day. In addition, the teacher reported that the small gains found for student 4 were very impressive as he made little to no gains in other targeted areas across the school year.

Given the lack of supports for teachers of students with significantly disabilities in rural schools, this study provides a viable option for providing meaningful access to the general curriculum. These teachers are often left with few targeted professional development opportunities, including those on how to meaningfully teach grade aligned academic skills. Technology such as the iPad and app described in the study can mitigate the lack of targeted supports.

Limitations/Future Research

Despite the overall positive findings, several limitations must be addressed. First, as is common in single case design, due to the small sample size, there is limited generalizability to other participants. Although we were able to demonstrate replication with an effect across all four participants, future research is needed to strengthen the effects through replication.

Second, we initially only conducted three baseline probes for all participants before bringing the first student into intervention. This occurred due to the limited timeline to expose the students to all chapter pairs before the students were out for a long holiday break. We also only conducted baseline on chapter 1 and 2 for student one before bringing this student into intervention with chapter 3 and 4. It would have been beneficial to probe this student in Ch. 3 and 4 to ensure the data remained low and stable before bringing this student into intervention. After starting intervention, we conducted a probe with all students in the next chapter pair, before moving into intervention on this chapter pair, in order to identify if the students might start to generalize the targeted skills to untrained content. In addition, all students were exposed to three repeated readings of the same content which could have led to practice effects and as a result be a potential internal validity threat. The researchers did ensure that all chapter pairs were equivalent in regard to length and complexity (i.e., lexile) and validated by a content expert in an attempt to address this potential threat. Also, the researchers wanted to provide an authentic grade aligned text experience by progressing through a Chapter book. Future research should investigate this intervention using a method with strong empirical support.

It is also important to consider that Students 3 and 4 did not receive intervention until chapters 5 and 6 which did not allow them to receive the intervention in earlier chapters. This may have contributed to Student 3's slower acquisition and the overall low data levels for Student 4. Future research should investigate the effects of different questions on each probe of earlier chapters, paying attention to the same types of questions (e.g., literal, inferential), but a different version each time.

Another limitation is that this study was conducted one to one, in a separate room in order to control for exposure to other participants. Given that the study was conducted in such a

controlled setting, it limits the ability to understand the potential effects in a typical classroom setting. Future research should investigate the use of this intervention in small or large group instruction as well as in inclusive settings. The impact of research to show the potential effects of this intervention on students with SIDD as well as students without disabilities in a regular, general education classroom would provide a demonstration of the need to more widely consider full inclusion placements for students with SIDD.

Finally, future research should investigate the effects of this intervention with high school students as most of the research thus far has been limited to younger students through middle school. The complexity of high school novels

Implications for Practice

This study demonstrated the use of an iPad to present adapted grade aligned text is a plausible option to promote listening comprehension for students with SIDD. Teachers need to consider resources like iPads, paired with strong systematic instructional strategies to provide engaging and meaningful access to grade aligned content. In addition, unique features of the intervention, such as embedded systematic instruction to promote listening comprehension should be utilized by teachers to promote listening comprehension across Bloom's Taxonomy for students with SIDD. Finally, instruction via the iPad should occur as a supplement to typical instruction versus a replacement. This supplemental instruction can promote independence and self-directed learning for students with SIDD that are typically for middle grade students without disabilities.

We can see a trending pattern that students with SIDD can be very successful with comprehension of grade aligned fictional text. As educators of students with SIDD, it is very important to continue to focus on increasing the comprehension abilities of these students. The

development of comprehension beyond just literal recall is essential for this population as it can lead to improved quality of life. Given the importance of providing meaningful instruction in grade aligned ELA skills, including comprehension, researchers need to continue to investigate plausible methods to promote these skills for students with SIDD.

References

Al Otaiba, S., & Hosp, M. K. (2004). Providing effective literacy instruction to students with Down syndrome. *Teaching Exceptional Children, 36*(4), 28-35.

Anderson, L.W., Krathwohl, D. R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., & Wittrock, M.C. (2001). *A taxonomy for learning, teaching, and assessing: a revision of bloom's taxonomy of educational objectives.* White Plains, NY: Longman.

Attainment Company. (2016). Access: Language Arts iPad App (1.2.5) [Mobile application software]. Retrieved from https://itunes.apple.com/us/app/attainments-access-language/id775947109?ls=1&mt=8

Authors (in preparation). *The effects of an English language arts treatment package for middle school students with significant disabilities.*

Authors (in submission). *A language arts iPad application for middle school students with significant disabilities: results from a single case design study.* Manuscript submitted for publication.

Bloom, B.S., (1956). *Taxonomy of educational objectives: the classification of educational goals, by a committee of college and university examiners.* White Plains, NY: Longman.

Browder, D. M., Gibbs, S., Ahlgrim-Delzell, L., Courtade, G., & Lee, A. (2007). *Early literacy skills builder*. Verona, WI: Attainment Company.

Browder, D. M., Wakeman, S. Y, Spooner, F., Algrim-Delzell, L., & Algozzine, B. (2006). Research on reading instruction for Individuals with significant cognitive disabilities. *Exceptional Children, 72*(4), 392-408.

Gast, D.L., & Ledford, J. (2010). Multiple Baseline and Multiple Probe Designs. In Gast, D.L., *Single Subject Research Methodology in Behavioral Sciences* (276-326). New York: Routledge.

National Governors Association (2010). Common Core State Standards. Retrieved from: http://www.corestandards.org/

Coyne, P., Pisha, B., Dalton, B., Zeph, L. A., & Smith, N. C. (2010). Literacy by design: A universal design for learning approach for students with significant intellectual disabilities. *Remedial and Special Education, 33*(3), 162-172.

Erickson, K., Hanser, G., Hatch, P., & Sanders, E. (2009). Research-based practices for creating access to the general curriculum in reading and literacy for students with significant intellectual disabilities. *Monograph prepared for the Council for Chief State School Officers (CCSSO) Assessing Special Education Students (ASES) State Collaborative on Assessment and Student Standards (SCASS).*

Katims, D. S. (2000). Literacy instruction for people with mental retardation: Historical highlights and contemporary analysis. *Education and Training in Mental Retardation and Developmental Disabilities*, *36*(4), l3-15.

Kliewer, C., & Biklen, D. (2001). School's not really a place for reading: A research synthesis of the literate lives of students with severe disabilities. *Research and Practice for Persons with Severe Disabilities*, *26*(1), 1-12.

Mims, P. J., Hudson, M. E., & Browder, D. M. (2012). Using read-alouds of grade-level biographies and systematic prompting to promote comprehension for students with moderate and severe developmental disabilities. *Focus on Autism and Other Developmental Disabilities, 27*(2), 67-80.

Mims, P. J., Lee, A., Browder, D. M., Zakas, T. L., & Flynn, S. (2012). Effects of a treatment package to facilitate English/language arts learning for middle school students with moderate to severe disabilities. *Education and Training in Autism and Developmental Disabilities*, 47(4), 414-425.

Spooner, F., Kemp-Inman, A., Ahlgrim-Delzell, L., Wood, L, & Davis, L. L. (2015). Generalization of literacy skills through portable technology for students with severe disabilities. *Research and Practice for Persons with Severe Disabilities*, *40*(1), 52-7.

Table 1.
Participant Demographics.

Student/ Ethnicity/ Gender	**Age/Grade**	**Test Given/ IQ**	**Verbal Ability**	**Disability**	**Reading**
St. 1/ Caucasian/ Female	12 year old/ 7th grade	WISC-IV/ IQ <40	Conversational	CP, Retts, Seizures, SID	Pre-K
St. 2/ Caucasian/ Male	12 year old/ 7th grade	WISC-IV/ IQ <40	Conversational	SID	K
St. 3/ Caucasian/ Female	9 year old/ 5th grade	WISC-IV/ IQ 50	Conversational	SID	Non-reader
St. 4/ Caucasian/ Male	11 year old/ 6th grade	RAIS/< 40	Extremely limited phrases	SID/ Autism	Non-reader

*CP- Cerebral Palsy; SID- Significant Intellectual Disability

Figure 1. Percent of unprompted correct responses to vocab and comprehension questions